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भारतीय मानक

पर्यावरण अवस्थाओं का वर्गीकरण

भाग 3 पर्यावरण पेरामीटर और उनकी कठोरताओं के समूहों का वर्गीकरण

अनुभाग 2 परिवहन

Indian Standard

CLASSIFICATION OF ENVIRONMENTAL CONDITIONS

PART 3 CLASSIFICATION OF GROUPS OF ENVIRONMENTAL PARAMETERS AND THEIR SEVERITIES

Section 2 Transportation

UDC 621·38·038 : 620·193 : 656·1

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NEW DELHI 110002

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Price Group 7

Environmental Testing Procedures Sectional Committee, LT 02

NATIONAL FOREWORD

This Indian Standard, which is identical with IEC Pub 721-3-2 (1985) 'Classification of environmental conditions — Part 3 : Classification of groups of environmental parameters and their severities — Transportation', issued by the International Electrotechnical Commission, was adopted by Bureau of Indian Standards on the recommendation of Environmental Testing Procedures Sectional Committee (LTD 02) and approval of the Electronics and Telecommunication Division Council.

The text of the IEC standard has been approved as suitable for publication as Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

> Wherever the words, 'International Standard' appear, referring to this standard, they should be read as 'Indian Standard'.

The concerned technical committee has reviewed the provisions of IEC 721-2-1 (1982) and IEC 721-3-0 (1984) referred in this standard and has decided that they are acceptable for use in conjunction with this standard.

Part 1 of this Indian Standard deals with classification of environmental parameters and their severities. The subsequent parts are intended to deal with the following:

a) Environmental conditions appearing in nature,

b) Classification or groups of environmental parameters and their severities

Amendment No. 1 issued to IEC Pub 721-3-2 (1985) has been incorporated.

Only the English language text in the Intetnational Standard has been retained while adopting it in this Indian Standard.

Indian Standard

CLASSIFICATION OF ENVIRONMENTAL CONDITIONS

PART 3 CLASSIFICATION OF GROUPS OF ENVIRONMENTAL PARAMETERS AND THEIR SEVERITIES

Section 2 Transportation

1. Scope

This standard classifies groups of environmental parameters and their severities to which a product is subjected while being transported from one place to another after being made ready for dispatch from the manufacturing factory.

The most commonly used methods of transportation have been taken into account, including the following:

- *Road transport:* cars, lorries, trucks, animals, conveyors
- *Rail transport:* trains, trams, conveyors
- *Water transport, inland and maritime:* ships, hovercraft, conveyors
- *Air transport:* aircraft, conveyors
- *Vertical transport:* cranes, transport lifts, cableways

The environmental conditions specified in this part of the publication are those met by the product being transported. If the product is packed, the environmental conditions apply to the package containing the product. Only severe conditions, which may be harmful to products, are included.

Conditions for storage and use are given in other parts of the standard.

2. Object

To classify groups of environmental parameters and their severities to which a product will be exposed when being transported on ground, water and in air, including loading and unloading.

A limited number of classes of environmental conditions are given, covering a broad field of application. The user of this standard should select the lowest classes necessary covering each of the conditions of the intended transportation. Some guidance for this is given in Appendix A.

3. General

Reference to IEC Publication 721-3-0: Classification of Environmental Conditions, Part 3: Classification of Groups of Environmental Parameters and Their Severities — Introduction, is strongly recommended in order to avoid misuse of the classes defined in other parts of IEC Publication 721-3.

The severities specified are those which will have a low probability of being exceeded. All specified values are maximum or limit values. These values may be reached, but do not occur permanently. Depending on the situation, there may be different frequencies of occurrence related to a certain period of time. Such frequencies of occurrence have not yet been included in this standard, but should be considered for any environmental parameter. They should additionally be specified if applicable.

It is planned to include information on duration and frequency of occurrence in IEC Publication 721-3-0.

Attention is drawn to the fact that combinations of the environmental parameters given may increase the effect on a product. This applies especially to the presence of high relative humidity in addition to biological conditions or to conditions of chemically or mechanically active substances.

4. Definitions

In addition to the definitions in Clause 3 of IEC Publication 721-1: Classification of Environmental Conditions, Part 1: Classification of Environmental Parameters and Their Severities, the following definitions apply to this standard:

4.1 *weatherprotected*

The product, packed or unpacked, is contained within an enclosure which affords some protection from the environment, ranging from a temperature controlled container to a waterproof cover placed over the product. Ventilation ranges from controlled air flow to the raising of part of a waterproof cover to allow for natural air flow.

4.2 *non-weatherprotected*

The product, packed or unpacked, is not protected in any way from the environment.

5. Classification of groups of environmental parameters and their severities

A limited number of classes for climatic conditions (K), biological conditions (B), chemically active substances (C), mechanically active substances (S) and mechanical conditions (M) are given in Tables I, II, III, IV and V. For a given product, reference should be made to the total set of classes, for example 2K2/2B1/2C2/2S2/2M3.

The basis of these classes is explained in Clause A3 of Appendix A.

The combination of the lowest classes 2K1/2B1/2C1/2S1/2M1 forms the conditions to which a product will be subjected when being transported under very restricted conditions. The combination of the highest classes 2K5/2B3/2C3/2S3/2M3 covers transportation under a very wide variety of conditions including very severe conditions.

A class with higher digit conditions normally includes all classes with lower digits.

For certain parameters it has not yet been possible to give quantitative values of severities.

A summary of the conditions covered by the classes is given in Clause A3 of Appendix A.

Note. — The classes contain values which do not appear in IEC Publication 721-1. It will be revised when all parts of IEC Publication 721-3 have been completed.

TABLE I

Classification of climatic conditions

Environmental parameter	Unit	Class						
		2K1	2K2	2K3	2K4	2K5	2K5H	2K5L
a) Low temperature, air	°C	+5	−25	−25	−40	−65	−25	−65
b) High temperature, air in unventilated enclosures[1]	°C	No	+60	+70	+70	+85	+85	+70
c) High temperature, air in ventilated enclosures or outdoor air[2]	°C	+40	+40	+40	+40	+55	+55	+40
d) Change of temperature, air/air[3]	°C	No	−25/+25	−25/+30	−40/+30	−65/+30	−25/+30	−65/+30
e) Change of temperature, air/water[3]	°C	No	No	+40/+5	+40/+5	+55/+5	+55/+5	+40/+5
f) Relative humidity, not combined with rapid temperature changes	% °C	75 +30	75 +30	95 +40	95 +45	95 +50	95 +50	95 +45
g) Relative humidity, combined with rapid temperature changes: air/air at high relative humidity[3]	% °C	No	No	95 −25/+30	95 −40/+30	95 −65/+30	95 −25/+30	95 −65/+30
h) Absolute humidity, combined with rapid temperature changes: air/air at high water content[4]	g/m³ °C	No	No	60 +70/+15	60 +70/+15	80 +85/+15	80 +85/+15	60 +70/+15
i) Low air pressure	kPa	70	70	70	70	30	30	30
j) Change of air pressure	kPa/min	No	No	No	No	6	6	6
k) Movement of surrounding medium, air	m/s	No	No	20	20	30	30	30
l) Precipitation, rain	mm/min	No	No	6	6	15	15	6
m) Radiation, solar	W/m²	700	700	1 120	1 120	1 120	1 120	1 120
n) Radiation, heat	W/m²	No	No	600	600	600	600	600
o) Water from sources other than rain[5]	m/s	No	No	1	1	3	3	3
p) Wetness	None	No	No	Conditions of wet surfaces				

[1] The high temperature of the surface of a product may be influenced by both the surrounding air temperature given here and the solar radiation through a window or other opening.

[2] The high temperature of the surface of a product is influenced by the surrounding air temperature given here and the solar radiation defined below.

[3] A direct transfer of the product between the two temperatures given is presumed.

[4] The product is assumed to be subjected to a rapid decrease of temperature only (no rapid increase). The figures of water content apply to temperatures down to the dew-point; at lower temperatures the relative humidity is assumed to be approximately 100%.

[5] The figure indicates the velocity of water and not the height of water accumulated.

TABLE II

Classification of biological conditions

Environmental parameter	Unit	Class		
		2B1	2B2	2B3
a) Flora	None	No	Presence of mould, fungus etc.	
b) Fauna	None	No	Presence of rodents or other animals harmful to products:	
			excluding termites	including termites

TABLE III

Classification of chemically active substances

Environmental parameter	Unit	Class		
		2C1	2C2	2C3
a) Sea salts	None	No	Conditions of salt mist	Conditions of salt water
b) Sulphur dioxide	mg/m³ cm³/m³	0.1 0.037	1.0 (0.3) 0.37 (0.11)	10 (5.0) 3.7 (1.85)
c) Hydrogen sulphide	mg/m³ cm³/m³	0.01 0.0071	0.5 (0.1) 0.36 (0.071)	10 (3.0) 7.1 (2.1)
d) Nitrogen oxides (expressed in the equivalent values of nitrogen dioxides)	mg/m³ cm³/m³	0.1 0.052	1.0 (0.5) 0.52 (0.26)	10 (3.0) 5.2 (1.56)
e) Ozone	mg/m³ cm³/m³	0.01 0.005	0.1 (0.05) 0.05 (0.025)	0.3 (0.1) 0.15 (0.05)
f) Hydrogen chloride	mg/m³ cm³/m³	0.1 0.066	0.5 (0.1) 0.33 (0.066)	5.0 (1.0) 3.3 (0.66)
g) Hydrogen fluoride	mg/m³ cm³/m³	0.003 0.0036	0.03 (0.01) 0.036 (0.012)	2.0 (0.1) 2.4 (0.12)
h) Ammonia	mg/m³ cm³/m³	0.3 0.42	3.0 (1.0) 4.2 (1.4)	35 (10) 49 (14)

Notes 1. — The figures given are maximum values, occurring over a 30 min period per day.

2. — The figures within brackets are the expected long-term mean values.

3. — The values given in cm³/m³ have been calculated from the values given in mg/m³ and refer to 20 °C and 101.3 kPa.

4. — The table uses rounded values.

TABLE IV

Classification of mechanically active substances

Environmental parameter	Unit	Class		
		2S1	2S2	2S3
a) Sand in air	g/m^3	No	0.1	10
b) Dust sedimentation	$mg/(m^2 \cdot h)$	No	3.0	3.0

TABLE V

Classification of mechanical conditions

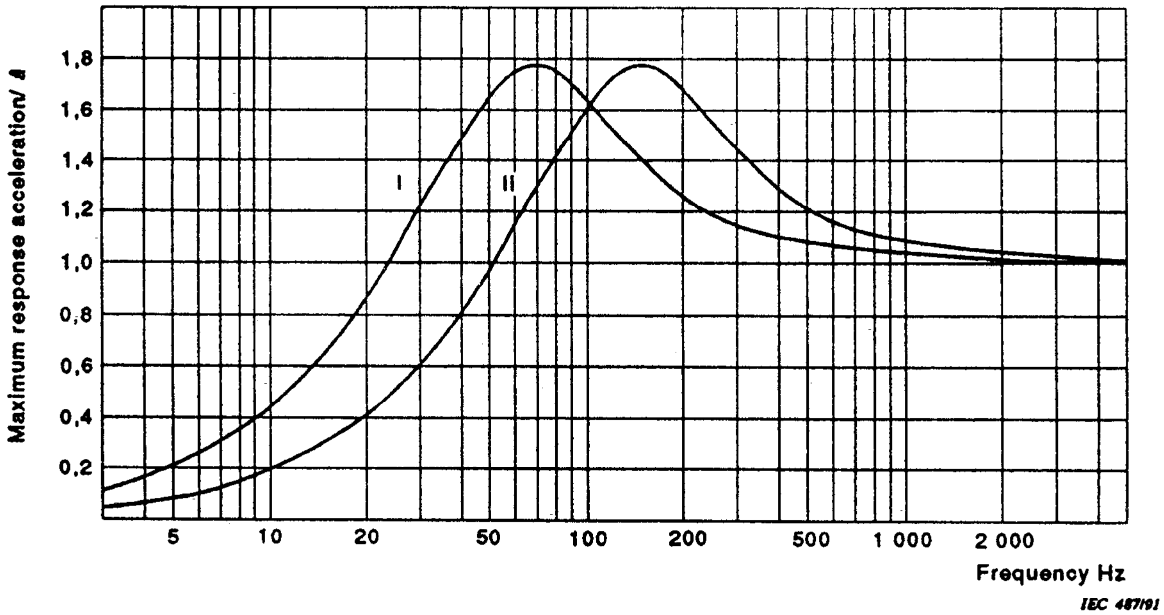
The mechanical conditions given apply to items placed on the floor of the transport compartments

Environmental parameter	Unit	Class		
		2M1	2M2	2M3
a) Stationary vibration sinusoidal:[1]				
displacement amplitude	mm	3.5	3.5	7.5
acceleration amplitude	m/s^2	10 15	10 15	20 40
frequency range	Hz	2-9 9-200 200-500	2-9 9-200 200-500	2-8 8-200 200-500
b) Stationary vibration, random:[1]				
acceleration spectral density	m^2/s^3	1 0.3	1 0.3	3 1
frequency range	Hz	10-200 200-2 000	10-200 200-2 000	10-200 200-2 000
c) Non-stationary vibration including shock:[2]				
shock response spectrum type I peak acceleration $\hat{a}$	m/s^2	100	100	300
shock response spectrum type II peak acceleration $\hat{a}$	m/s^2	No	300	1 000
d) Free fall:				
mass less than 20 kg	m	0.25	1.2	1.5
mass 20 kg to 100 kg	m	0.25	1.0	1.2
mass more than 100 kg	m	0.1	0.25	0.5
e) Toppling:				
mass less than 20 kg	None	Toppling around any of the edges		
mass 20 kg to 100 kg	None	No	Toppling around any of the edges	
mass more than 100 kg	None	No	No	Toppling around any of the edges
f) Rolling, pitching				
angle[3]	degree	No	±35	±35
period	s	No	8	8
g) Steady-state acceleration	m/s^2	20	20	20
h) Static load	kPa	5	10	10

[1] The frequency range may be limited to 200 Hz for transportation on parts of the vehicle with high internal damping.

[2] See Figure 1. For explanation see IEC Publication 721-1, Sub-clause 5.3.

[3] An angle of 35° only occurs temporarily, but angles up to 22.5° can be reached for long periods of time.



Example of durations for half-sine pulse:

Spectrum type I: duration 11 ms
Spectrum type II: duration 6 ms

Figure 1 - Model shock response spectra (first order maximax shock response spectra). For explanation see note 6 relating to table I of IEC 721-1 (1990)

APPENDIX A

SURVEY OF CONDITIONS AFFECTING THE CHOICE OF ENVIRONMENTAL PARAMETERS AND THEIR SEVERITIES

A1. General

In this appendix the basis of the classes is explained. It gives a survey of conditions affecting the choice of environmental parameters and their severities, and it contains a summary of the conditions covered by each class, including samples of application.

A2. Survey of conditions

For each environmental parameter the various possible conditions which will result in different levels of environmental conditions are presented. An effort has been made to arrange the conditions in order of increasing severities.

The first column of the tabulated Sub-clauses A2.1 to A2.5 on pages 21 to 31 describes the conditions. In the vertical columns headed "Class", a × indicates the conditions covered by the class. The lowest class covering a certain condition may be found by reading horizontally from that condition to the first × encountered.

The procedure of finding an appropriate class as described above is valid for all the Sub-clauses, but the first part of Sub-clause A2.1 (pages 21 to 23) contains the additional factor of type of climate, given in columns 2 to 10, to which attention has to be paid.

The lowest class covering a certain condition can thus be found by reading vertically down the relevant type of climate column to the first × in the horizontal line of the relevant condition, then reading horizontally to the right to the first × encountered as previously described.

The types of climate are described in IEC Publication 721-2-1: Classification of Environmental Conditions, Part 2: Environmental Conditions Appearing in Nature — Temperature and Humidity, and are:

Extremely Cold (except the Central Antarctic)
Cold
Cold Temperate
Warm Temperate
Warm Dry
Mild Warm Dry
Extremely Warm Dry
Warm Damp
Warm Damp, Equable

It should be noted that the fact that a certain condition referred to in this appendix is covered by a certain class does not necessarily mean that the class describes, for each single parameter, the lowest environmental severity needed to cover the condition.

Note. — Accidental incidents are not included. In certain cases the possibility of their occurrence may, however, need to be taken into account. An example is damage of a package in the hold of a ship due to leaking fluid from a neighbouring container.

A2.1 *K. Climatic conditions*

Condition of transportation	Type of climate									Class						
	Extremely Cold	Cold	Cold Temperate	Warm Temperate	Warm Dry	Mild Warm Dry	Extremely Warm Dry	Warm Damp	Warm Damp, Equable	2K1	2K2	2K3	2K4	2K5	2K5H	2K5L
a) Low temperature, air °C										+5	−25	−25	−40	−65	−25	−65
Weatherprotected with heating (protected against freezing)	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Non-weatherprotected, or weatherprotected without heating, or heated aircraft holds only				×	×	×	×	×	×		×	×	×	×	×	×
			×	×	×	×	×	×	×				×	×		×
	×	×	×	×	×	×	×	×	×					×		×
Unheated aircraft holds	×	×	×	×	×	×	×	×	×					×		×
b) High temperature, air in unventilated enclosures °C										No	+60	+70	+70	+85	+85	+70
Unventilated enclosures	×	×	×	×	×	×		×	×			×	×	×	×	×
	×	×	×	×	×	×	×	×	×					×	×	
c) High temperature, air in ventilated enclosures or outdoor air °C										+40	+40	+40	+40	+55	+55	+40
Weatherprotected with temperature control	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Weatherprotected with ventilation, or non-weatherprotected	×	×	×	×	×	×		×	×	×	×	×	×	×	×	×
	×	×	×	×	×	×	×	×	×					×	×	
d) Change of temperature, air/air °C										No	−25/ +25	−25/ +30	−40/ +30	−65/ +30	−25/ +30	−65/ +30
Products not moved between outdoors and indoors	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Products moved between outdoors and indoors or from unheated aircraft holds to outdoors				×	×	×	×	×	×			×	×	×	×	×
	×	×	×	×	×	×	×	×	×					×		×

A2.1 *K. Climatic conditions (continued)*

Condition of transportation	Type of climate									Class						
	Extremely Cold	Cold	Cold Temperate	Warm Temperate	Warm Dry	Mild Warm Dry	Extremely Warm Dry	Warm Damp	Warm Damp, Equable	2K1	2K2	2K3	2K4	2K5	2K5H	2K5L
e) Change of temperature air/water[1] °C										No	No	+40/ +5	+40/ +5	+55/ +5	+55/ +5	+40/ +5
Protected from rain, or not subjected to water from other sources	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Subjected to rain or water jets directly after being subjected to solar radiation	× ×	× ×	× ×	× ×	× ×	× ×	 ×	× ×	× ×			×	×	× ×	× ×	×
f) Relative humidity, not combined with rapid temperature change % °C										75 +30	75 +30	95 +40	95 +45	95 +50	95 +50	95 +45
Humidity controlled weatherprotected conditions	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Heated and ventilated weatherprotected conditions, or non-weatherprotected conditions	×	×	×	×	×	×	×	×	×			×	×	×	×	×
Weatherprotected, unventilated compartments with wet floors and/or walls, subjected to solar radiation	× ×	× ×	× ×	× ×	× ×	× ×	 ×	× ×	× ×				×	× ×	× ×	×
g) Relative humidity, combined with rapid temperature changes air/air at high relative humidity % °C										No No	No No	95 −25/ +30	95 −40/ +30	95 −65/ +30	95 −25/ +30	95 −65/ +30
Products not moved between outdoors and indoors, or negligible temperature changes	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Products moved between outdoors and indoors, or products moved from aircraft holds to outdoors	 ×	 ×	 × ×	× × ×	× × ×	× × ×	× × ×	× × ×	× × ×			×	× ×	× × ×	×	× × ×
h) Absolute humidity, combined with rapid temperature changes air/air at high water content[2] g/m³ °C										No No	No No	60 +70/ +15	60 +70/ +15	80 +85/ +15	80 +85/ +15	60 +70/ +15
In enclosures subjected to rain or water jets after being subjected to solar radiation	× ×	× ×	× ×	× ×	× ×	× ×	 ×	× ×	× ×			×	×	× ×	× ×	×

[1] The lower temperature is equivalent to the temperature of tap water.

[2] The lower temperature is equivalent to the temperature of rain water in warm periods.

A2.1 *K. Climatic conditions (continued)*

Condition of transportation	Class						
	2K1	2K2	2K3	2K4	2K5	2K5H	2K5L
i) Low air pressure[3] kPa	70	70	70	70	30	30	30
Altitudes where ground transport can take place and in pressurized aircraft holds	×	×	×	×	×	×	×
Unpressurized aircraft holds					×	×	×
j) Change of air pressure kPa/min	No	No	No	No	6	6	6
Not subjected to rapid altitude changes	×	×	×	×	×	×	×
Subjected to altitude changes in unpressurized aircraft holds					×	×	×
k) Movement of surrounding medium, air m/s	No	No	20	20	30	30	30
Indoor, weatherprotected conditions, or not subjected to wind	×	×	×	×	×	×	×
Outdoor, without protection from wind. World-wide climatic areas excluding hurricanes			×	×	×	×	×
Subjected to open transport without protection from speedwind. World-wide climatic areas					×	×	×
l) Precipitation, rain mm/min	No	No	6	6	15	15	6
Protected from precipitation	×	×	×	×	×	×	×
Non-weatherprotected or not protected from precipitation. Climatic areas with normal rain intensities			×	×	×	×	×
Non-weatherprotected or not protected from precipitation. World-wide climatic areas					×	×	
m) Radiation, solar W/m²	700	700	1 120	1 120	1 120	1 120	1 120
Non-weatherprotected but protected against solar radiation	×	×	×	×	×	×	×
Weatherprotected, or exposed to solar radiation only through windows. World-wide climatic areas	×	×	×	×	×	×	×
Non-weatherprotected, or exposed to direct solar radiation. World-wide climatic areas			×	×	×	×	×
n) Radiation, heat W/m²	No	No	600	600	600	600	600
No heat sources in the vicinity of the product	×	×	×	×	×	×	×
Heat source in the vicinity of the product			×	×	×	×	×

---

[3] 70 kPa represents a limit value for ground transport, normally at about 3 000 m altitude. In some geographical areas ground transport may take place at higher altitudes. 30 kPa corresponds to approximately 9 000 m.

A2.1 *K. Climatic conditions (continued)*

Condition of transportation	Class						
	2K1	2K2	2K3	2K4	2K5	2K5H	2K5L
o) Water from sources other than rain (velocity) m/s	No	No	1	1	3	3	3
Protected against water	×	×	×	×	×	×	×
Subjected to splashing water (via ground)			×	×	×	×	×
Subjected to sprays and jets (e.g. from cleaning), or subjected to sea waves on open decks of ships					×	×	×
p) Wetness	No	No	Conditions of wet surfaces				
In dry conditions	×	×	×	×	×	×	×
In wet areas, e.g. on wet floors			×	×	×	×	×

A2.2 *B. Biological conditions*

Condition of transportation	Class		
	2B1	2B2	2B3
a) Flora	No	Presence of mould, fungus etc.	
Areas with negligible risks of growth of mould, fungus, etc., or protected from growth of mould, fungus, etc.	×	×	×
Areas with risks of growth of mould, fungus, etc. No protection from growth of mould, fungus etc.		×	×
b) Fauna	No	Presence of rodents or other animals harmful to products:	
		excluding termites	including termites
Areas with negligible attacks of termites, rodents and other animals, which may damage the product, or protected from animals	×	×	×
Areas with risks of attacks by rodents and other animals excluding termites. No protection from animals		×	×
Areas with risks of attacks of animals including termites			×

A2.3 *C. Chemically active substances*

Condition of transportation	Class		
	2C1	2C2	2C3
a) Sea salts	No	Conditions of salt mist	Conditions of salt water
Indoors, weatherprotected (including indoor sea transport)	×	×	×
Non-weatherprotected, land transport		×	×
Non-weatherprotected, sea transport			×
b) Sulphur dioxide mg/m^3	0.1	1.0	10
c) Hydrogen sulphide mg/m^3	0.01	0.5	10
d) Nitrogen oxides mg/m^3	0.1	1.0	10
e) Ozone mg/m^3	0.01	0.1	0.3
f) Hydrogen chloride mg/m^3	0.1	0.5	5.0
g) Hydrogen fluoride mg/m^3	0.003	0.03	2.0
h) Ammonia mg/m^3	0.3	3.0	35
Areas without industry or permanent motor traffic, not in vicinity of industrial areas or enclosed spaces in areas with moderate industrial activities and traffic	×	×	×
Areas with normal industrial activities not including industry with emissions of large quantities of chemical pollutants		×	×
Areas with industrial sources with high chemical emissions			×

A2.4 *S. Mechanically active substances*

Condition of transportation	Class		
	2S1	2S2	2S3
a) Sand in air g/m^3	No	0.1	10
b) Dust sedimentation mg/(m^2·h)	No	3.0	3.0
Weatherprotected and protected from particles. Cleaning does not include sweeping of dusty floors	×	×	×
Weatherprotected but not protected from particles. Dusty places subjected to sweeping and other dusting activities. Non-weatherprotected and not protected from particles. World-wide except sand deserts		×	×
Non-weatherprotected and not protected from particles. World-wide			×

A2.5 *M. Mechanical conditions*

Condition of transportation	Class		
	2M1	2M2	2M3
a) Stationary vibration, sinusoidal: displacement amplitude mm acceleration amplitude m/s^2 frequency range Hz	3.5 10 15 2-9 9-200 200-500	3.5 10 15 2-9 9-200 200-500	7.5 20 40 2-8 8-200 200-500
Propeller aircraft. Ships. Air-cushioned road vehicles, air-cushioned trailers, other road vehicles in areas with well-developed road systems, trains with soft suspension, fork-lift trucks	×	×	×
Road vehicles in areas without well-developed road systems, trailers, trains with hard suspension			×
b) Stationary vibration, random: acceleration spectral density m^2/s^3 frequency range Hz	1 0.3 10-200 200-2 000	1 0.3 10-200 200-2 000	3 1 10-200 200-2 000
Jet aircraft. Air-cushioned road vehicles, air-cushioned trailers, other road vehicles in areas with well-developed road systems, trains with soft suspension, fork-lift trucks (only 10 Hz to 500 Hz)	×	×	×
Road vehicles in areas without well-developed road systems, trailers, trains with hard suspension (only 10 Hz to 500 Hz)			×
c) Non-stationary vibration, including shock: shock response spectrum type I peak acceleration $\hat{a}$ m/s^2 shock response spectrum type II peak acceleration $\hat{a}$ m/s^2	100 No	100 300	300 1 000
Aircraft, ships, air-cushioned road vehicles	×	×	×
Road vehicles in areas with well-developed road systems, air-cushioned trailers, trains with specially designed buffers to reduce shocks, fork-lift trucks		×	×
Road vehicles in areas without well-developed road systems, trailers, trains (including shunting)			×

A2.5 *M. Mechanical conditions (continued)*

Condition of transportation	Class		
	2M1	2M2	2M3
d) Free fall:			
mass under 20 kg m	0.25	1.2	1.5
mass 20 kg to 100 kg m	0.25	1.0	1.2
mass over 100 kg m	0.1	0.25	0.5
Loading and unloading only with mechanical means (cranes, fork-lift trucks, conveyors, etc.). Risk of dropping not taken into account	×	×	×
Manual loading and unloading of items of mass under 20 kg. Transport on animals		×	×
Manual loading and unloading of items of mass up to 100 kg. Transport on animals			×
e) Toppling:			
mass under 20 kg	Toppling around any of the edges		
mass 20 kg to 100 kg	No	Toppling around any of the edges	
mass over 100 kg	No	No	Toppling around any of the edges
Items of mass under 20 kg: subjected to toppling. Items of mass over 20 kg: not subjected to toppling, loading and unloading only by mechanical means	×	×	×
Items of mass 20 kg to 100 kg: subjected to toppling, manual loading and unloading. Items of mass over 100 kg: not subjected to toppling, loading and unloading only by mechanical means		×	×
Items of mass over 100 kg: subjected to toppling			×
f) Rolling, pitching:			
angle degree	No	±35	±35
period s	No	8	8
Not transported by ships	×	×	×
Transported by ships		×	×
g) Steady-state acceleration m/s^2	20	20	20
All kinds of transport including aircraft	×	×	×
h) Static load kPa	5	10	10
Subjected to load from stacking, max. height 3.5 m	×	×	×
Subjected to load from stacking, max. height 7 m		×	×

A3. Summary of conditions covered by the classes

This summary contains a description of the complete classification and refers to examples of application.

A3.1 *K. Climatic conditions*

These are covered by seven class notations as follows:

2K1 2K1 covers in general terms transportation in weatherprotected, heated and ventilated conditions. The high air temperatures are limited to those within the General Open-air Climates[1]. The conditions of humidity of the World-wide Open-air Climates are not more severe than in the General Open-air Climates, and therefore such a limitation is not made for the humidity conditions.

The product is not moved between cold outdoor and warm indoor conditions.

The product may be exposed to solar radiation through a window or other opening. It is not placed close to heating elements and not subjected to water from splashing, wet walls, etc.

2K2 In addition to the conditions covered by 2K1, 2K2 includes weatherprotected conditions without heating in the General Open-air Climates, excluding Cold and Cold Temperate Climates. Transportation in ventilated enclosures is included.

The product may be transported in heated, pressurized aircraft holds.

2K3 In addition to the conditions covered by 2K2, 2K3 includes transportation in unventilated enclosures and in non-weatherprotected conditions with restrictions to the General Open-air Climates, excluding Cold and Cold Temperate Climates. Transportation by air only in heated, pressurized holds is included.

The product may be moved between cold outdoor and warm indoor conditions. It may be exposed to direct solar radiation, precipitation and splashing water.

The product may be placed on a wet floor and inside an enclosure, which is subjected to sunshine, rain, etc. Outdoor exposure does not include subjection to sea waves. The product may be placed close to heating elements.

2K4 In addition to the conditions covered by 2K3, 2K4 includes non-weatherprotected transportation in Cold Temperate Climate.

2K5 In addition to the conditions covered by 2K4, 2K5 includes transportation in unventilated enclosures and in non-weatherprotected conditions world-wide, also including transportation in unpressurized aircraft holds. The product may be subjected to sea waves when being transported on open decks of ships and may also be subjected to water jets from cleaning.

2K5H Class 2K5H is similar to 2K5, but the low temperature condition is the same as that of class 2K3.

2K5L Class 2K5L is similar to 2K5, but the high temperature conditions are the same as those of class 2K4.

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[1] Publication 721-2-1 defines the types and groups of climates.

A3.2 *B. Biological conditions*

These are covered by three class notations as follows:

2B1 2B1 covers transportation in areas without particular risks of biological attacks (from flora or fauna). This includes transportation in compartments of such construction that mould growth, attacks of animals, etc, are not probable.

2B2 In addition to the conditions covered by 2B1, 2B2 includes areas and conditions where mould growth, attacks of animals except termites may occur.

2B3 In addition to the conditions covered by 2B2, 2B3 includes areas where attacks of termites may occur.

A3.3 *C. Chemically active substances*

These are covered by three class notations as follows:

2C1 2C1 covers all cases of transportation, where the product is placed indoors in such a way that it is protected from salt mist. Transportation only takes place in areas with moderate industrial activities and traffic.

2C2 In addition to the conditions covered by 2C1, 2C2 also includes outdoor transportation except sea transport on open decks of ships. Transportation also takes place in areas with normal industrial activities, excluding those where large quantities of chemical pollutants are emitted.

2C3 2C3 covers all transport conditions including transportation by ships, unprotected from salt mist, and in areas with very high levels of chemical pollutants.

A3.4 *S. Mechanically active substances*

These are covered by three class notations as follows:

2S1 2S1 covers all cases of transportation, where the product is placed indoors, protected from sand and dust.

2S2 In addition to the conditions covered by 2S1, 2S2 also includes outdoor transportation as well as indoor, where sweeping of dusty floors is taken into account. Transportation in sand desert areas is not included.

2S3 In addition to the conditions covered by 2S2, 2S3 also includes outdoor transportation in sand desert areas.

A3.5 *M. Mechanical conditions*

These are covered by three class notations as follows:

2M1 2M1 covers mechanical loading as well as transportation in aircraft, lorries and air-cushioned trucks and trailers.

2M2 In addition to the conditions covered by 2M1, 2M2 includes transportation in all kinds of lorries and trailers in areas with well-developed road systems. It also includes transportation by trains with specially designed shock reducing buffers and by ships.

2M3 In addition to the conditions covered by 2M2, 2M3 includes all other kinds of transportation, also in areas without well-developed road systems.

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